



# SC COST-BENEFIT ANALYSIS - PORTFOLIO SUMMARY

## Net Present Value (Primary Costs and Benefits) and IMPLAN (Secondary Benefits)

Total NPV Costs	Total NPV Benefits	NPV Benefit-Cost Ratio	Total IMPLAN Benefits	NPV + IMPLAN Benefit-Cost Ratio
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### PROGRAMS

<b>Targeted Underground</b>	<b>\$</b>	<b>43,647,083</b>	<b>\$</b>	<b>318,559,161</b>	<b>7.3</b>	<b>\$</b>	<b>202,132,708</b>	<b>11.9</b>
2019 Converse Heights - E. Sherwood	\$	11,258,558	\$	49,640,184	4.4			
2019 Merrifield Park	\$	4,381,709	\$	7,742,315	1.8			
2019 Park Hills	\$	4,482,243	\$	36,384,232	8.1			
2019 Woodside	\$	1,063,231	\$	13,910,695	13.1			
2019 Hall Circle	\$	454,486	\$	6,922,450	15.2			
2019 Hamden Circle	\$	454,486	\$	9,889,257	21.8			
2020 Cedar Springs	\$	487,633	\$	1,557,689	3.2			
2020 Chanticleer	\$	3,848,712	\$	26,117,440	6.8			
2020 Del Norte	\$	3,625,533	\$	12,340,514	3.4			
2019 Hampton Heights	\$	2,685,732	\$	20,000,547	7.4			
2020 Ind. - Providence	\$	1,556,218	\$	20,296,417	13.0			
2020 Spartanburg County Club	\$	684,169	\$	2,561,197	3.7			
2020 Arrowwood	\$	939,039	\$	42,404,068	45.2			
2020 McFarlin St	\$	460,983	\$	11,641,641	25.3			
2020 Mimosa Dr	\$	751,231	\$	1,574,853	2.1			
2020 Sherwood	\$	1,636,924	\$	28,723,608	17.5			
2020 Yaupon Dr	\$	1,102,418	\$	15,310,327	13.9			
2021 Alleghany Ridge	\$	1,733,671	\$	5,845,639	3.4			
2021 Tara Village	\$	2,040,106	\$	5,696,087	2.8			
<b>Transformer Retrofit</b>	<b>\$</b>	<b>21,609,809</b>	<b>\$</b>	<b>102,100,761</b>	<b>4.7</b>	<b>\$</b>	<b>72,204,733</b>	<b>8.1</b>
<b>IVVC</b>	<b>\$</b>	<b>181,912,000</b>	<b>\$</b>	<b>183,148,000</b>	<b>1.0</b>	<b>\$</b>	<b>66,722,771</b>	<b>1.4</b>
<b>DSDR</b>	<b>\$</b>	<b>1,880,000</b>	<b>\$</b>	<b>34,002,000</b>	<b>18.1</b>	<b>\$</b>	<b>17,609,236</b>	<b>27.5</b>
<b>SOG</b>	<b>\$</b>	<b>89,254,454</b>	<b>\$</b>	<b>311,943,547</b>	<b>3.5</b>	<b>\$</b>	<b>208,942,448</b>	<b>5.8</b>
<b>Transmission - Oil Breaker Replacements</b>	<b>\$</b>	<b>18,063,566</b>	<b>\$</b>	<b>37,656,127</b>	<b>2.1</b>	<b>\$</b>	<b>4,800,939</b>	<b>2.4</b>
DEP Asset Replacements	\$	1,758,460	\$	4,892,094	2.8			2.8
DEC Asset Replacements	\$	16,305,106	\$	32,764,034	2.0			2.0
<b>Transmission - Transformer Bank Replacements</b>	<b>\$</b>	<b>17,234,309</b>	<b>\$</b>	<b>18,206,110</b>	<b>1.1</b>	<b>\$</b>	<b>1,172,614</b>	<b>1.1</b>
DEP Asset Replacements	\$	6,778,309	\$	6,610,550	1.0			1.0
DEC Asset Replacements	\$	10,455,999	\$	11,595,560	1.1			1.1

### PROJECTS

<b>LDI/HIS</b>	<b>\$</b>	<b>12,344,393</b>	<b>\$</b>	<b>431,191,852</b>	<b>34.9</b>	<b>\$</b>	<b>308,905,628</b>	<b>60.0</b>
Cheraw River Crossing	\$	6,970,787	\$	225,648,390	32.4	\$	161,654,394	55.6
Brushy Creek	\$	1,100,000	\$	13,241	0.0	\$	9,486	0.0
Whitehall Hurricane Creek	\$	150,000	\$	8,559,373	57.1	\$	6,131,930	97.9
Whitehall Sandy Springs	\$	200,000	\$	22,996,612	115.0	\$	16,474,761	197.4
Fants Grove	\$	25,000	\$	2,148,633	85.9	\$	1,539,280	147.5
Moore Camp Croft	\$	1,381,378	\$	21,668,393	15.7	\$	15,523,226	26.9
Moore Woodruff	\$	1,161,798	\$	80,769,639	69.5	\$	57,863,329	119.3
Eddy Road Panorama	\$	1,355,431	\$	69,387,572	51.2	\$	49,709,222	87.9

	Total NPV Costs	Total NPV Benefits	NPV Benefit-Cost Ratio	Total IMPLAN Benefits	NPV + IMPLAN Benefit-Cost Ratio
<b>Transmission - Flooded Substation</b>	<b>\$ 5,678,227</b>	<b>\$ 2,835,617</b>	<b>0.5</b>	<b>\$ 18,081</b>	<b>0.5</b>
Whiteville	\$ 1,119,513	\$ 594,356	0.5	\$ 4,180	0.5
Goldsboro Weil	\$ 655,927	\$ 453,810	0.7	\$ 1,269	0.7
Grifton	\$ 1,675,932	\$ 494,927	0.3	\$ 2,121	0.3
Greenville (Note 7)	\$ 1,203,461	\$ 900,007	0.7	\$ 10,510	0.8
Lee Steam Electric Plant	\$ 1,023,395	\$ 392,517	0.4	\$ -	0.4
<b>Transmission - Line Rebuilds</b>	<b>\$ 2,132,612</b>	<b>\$ 5,381,850</b>	<b>2.5</b>	<b>\$ 1,147,013</b>	<b>3.1</b>
Sumter	\$ 253,266	\$ 1,488,528	5.9	\$ 1,066,381	10.1
Folkstone-Jacksonville	\$ 1,102,919	\$ 3,065,649	2.8	\$ 63,491	2.8
Weatherspoon-Raeford	\$ 776,426	\$ 827,673	1.1	\$ 17,142	1.1
<b>Transmission - 44kV</b>	<b>\$ 10,805,259</b>	<b>\$ 249,108,873</b>	<b>23.1</b>	<b>\$ 25,795,995</b>	<b>25.4</b>
Belfast	\$ 1,446,642	\$ 29,663,867	20.5	\$ 21,251,179	35.2
Spurrier	\$ 1,187,288	\$ 16,956,953	14.3	\$ 351,187	14.6
Capps-Hendersonville	\$ 1,432,193	\$ 34,847,476	24.3	\$ 721,709	24.8
Quebec	\$ 1,241,971	\$ 46,642,753	37.6	\$ 965,995	38.3
Rockford	\$ 49,832	\$ 1,546,230	31.0	\$ 32,023	31.7
Cabin Creek-Stevens	\$ 832,548	\$ 18,192,745	21.9	\$ 376,781	22.3
Spindale	\$ 790,308	\$ 15,355,647	19.4	\$ 318,023	19.8
Hendersonville Main	\$ 1,212,031	\$ 44,073,313	36.4	\$ 912,780	37.1
Rockford - Level Cr	\$ 985,017	\$ 20,583,633	20.9	\$ 426,297	21.3
Spindale - Fairview	\$ 1,415,311	\$ 20,601,080	14.6	\$ 426,659	14.9
Duke Univ. Underground	\$ 212,117	\$ 645,176	3.0	\$ 13,362	3.1
<b>Total Programs/Projects with CBAs (Optimize)</b>	<b>\$ 404,561,711</b>	<b>\$ 1,694,133,900</b>	<b>4.2</b>	<b>\$ 909,452,168</b>	<b>6.4</b>
<b>Other (Modernize/Protect)</b>	<b>\$ 154,030,739</b>				
<b>Total Portfolio</b>	<b>\$ 558,592,450</b>	<b>\$ 1,694,133,900</b>	<b>3.0</b>	<b>\$ 909,452,168</b>	<b>4.7</b>

**Duke Energy Grid Improvement Plan (GIP) Economic Benefits Assessment**  
**Program: Distribution System Demand Response (DSDR)**

*Prepared by: Joseph Von Nessen, Ph.D.*

*Last Revised: 3/5/19*

**Measuring Primary and Secondary Economic Benefits**

To determine most of the primary economic benefits that would result from this program, Duke Energy utilized a system production cost model called PROSYM used in the development of the Integrated Resource Plan (IRP). The annual system production cost of both the non-DSDR and the DSDR scenarios were derived and demonstrated the annual production cost savings associated with the implementation of DSDR.

These direct cost savings, however, do not represent the full economic benefits of the DSDR program. When businesses experience these cost reductions, over time they will begin to expand their economic activities through additional purchases of raw inputs and the hiring of additional employees. These are known as secondary economic benefits. Additional secondary economic benefits will also accrue to a variety of local businesses when residential customers spend wages with these local businesses that they are no longer losing as a result of temporary employer shut downs.

Thus, both primary and secondary economic benefits are generated as a result of the program that, together, represents the total economic benefits of the DSDR program initiative. To specifically estimate the secondary economic benefits, the *IMPLAN* economic model is used.

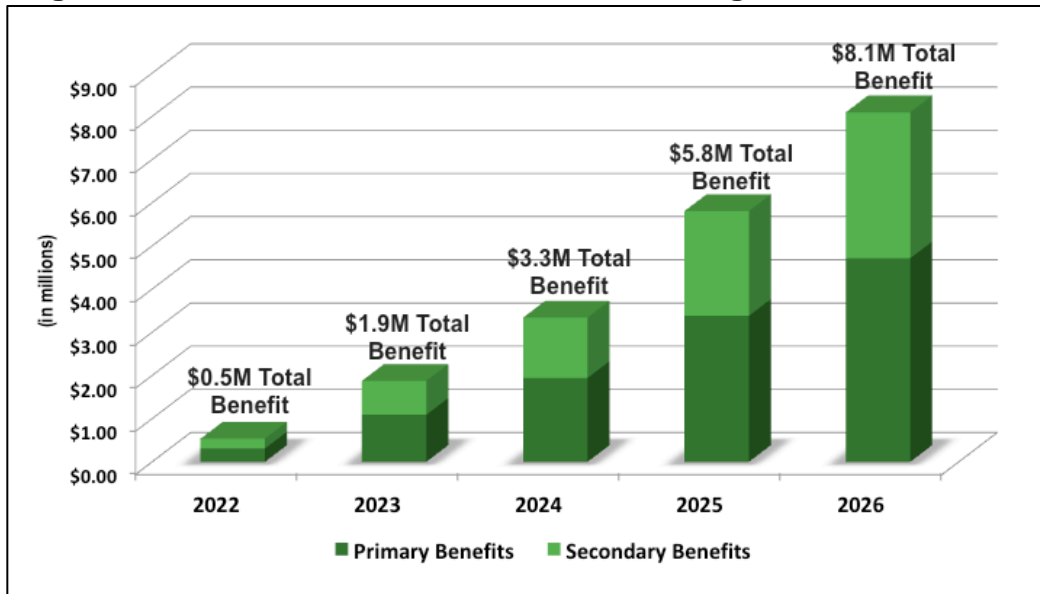
**Main Results: Economic Benefits of DSDR Program Initiative**

Figure 1 summarizes the total cumulative economic benefits (primary and secondary) in South Carolina resulting from the DSDR program during the first five years in which customers will experience benefits. Note that these benefits increase over time (between 2022 and 2026) as new infrastructure comes online. In sum, the cumulative economic benefits will total \$8.1 million by the year 2026.<sup>1</sup>

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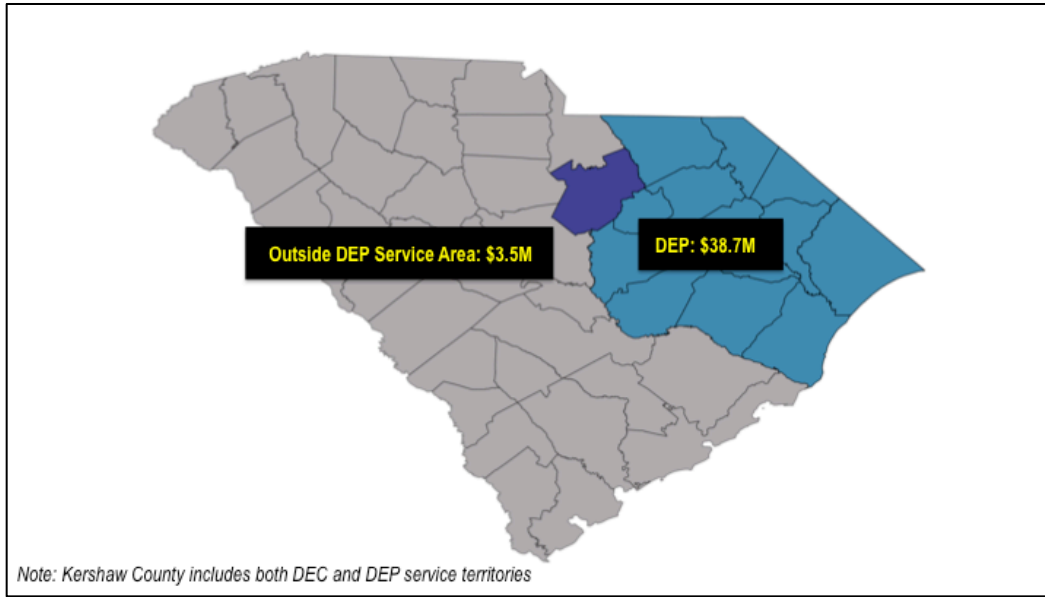
<sup>1</sup> All economic benefits are expressed in current (2019) dollars.

**Figure 1: Cumulative Economic Benefits of DSDR Program in SC: 2022-2026**



The majority of the economic benefits resulting from the South Carolina DSDR program will accrue to counties in which the Duke Energy service territory extends. However, the benefits will not be distributed equally. In addition to the fact that Duke Energy customers are not equally distributed within the service territory, economic benefits resulting from improvements that accrue to Duke Energy customers will also generate economic spillover effects to the surrounding regions. These spillover effects come in the form of both additional spending with vendors/suppliers on the part of non-residential customers and the spending of additional earned wages on the part of residential customers. Not all spending activities on the part of Duke Energy customers take place within the Duke Energy service territory – thus a portion of the total economic benefits resulting from the DSDR program will extend statewide. Figures 2 shows the regions projected to experience the largest percentage of these economic benefits over time.

**Figure 2: Cumulative Total Economic Benefits of DSDR in S.C. by Service Area**



Approximately 91.6 percent of the total economic benefits associated with the DSDR program are estimated to accrue to the Duke Energy Progress (DEP) service territory, which is projected to total approximately \$38.7 million between 2022 and 2044. The remaining 8.4 percent of the economic benefits will likely accrue to counties outside of the service area (\$3.5 million). ***Thus, the DSDR program is projected to generate over \$42 million in total economic benefits for South Carolina during its 25-year benefit period, including \$17.6 million in secondary economic benefits.***

## **Duke Energy Grid Improvement Plan (GIP) Economic Benefits Assessment**

### ***Program: Integrated Volt/Var Control (IVVC)***

*Prepared by: Joseph Von Nessen, Ph.D.*

*Last Revised: 3/5/19*

### ***Measuring Primary and Secondary Economic Benefits***

Duke Energy estimates that approximately 418,709 South Carolina customers will benefit from the IVVC program initiative throughout its complete 25-year benefit period. Approximately 367,152 (87.7%) of these are residential customers while the remaining 51,557 are non-residential.

To determine most of the *primary* economic benefits that would result from this program, Duke Energy utilized a system production cost model called PROSYM used in the development of the Integrated Resource Plan (IRP). The annual system production cost of both the non-IVVC and the IVVC scenarios were derived and demonstrated the annual production cost savings associated with the implementation of IVVC.

These direct cost savings, however, do not represent the full economic benefits of the IVVC program. When businesses experience these cost reductions, over time they will begin to expand their economic activities through additional purchases of raw inputs and the hiring of additional employees. These are known as secondary economic benefits. Additional secondary economic benefits will also accrue to a variety of local businesses when residential customers spend wages with these local businesses that they are no longer losing as a result of temporary employer shut downs.

Thus, both *primary* and *secondary* economic benefits are generated as a result of the program that, together, represents the total economic benefits of the IVVC program initiative. To specifically estimate the secondary economic benefits, the *IMPLAN* economic model is used.

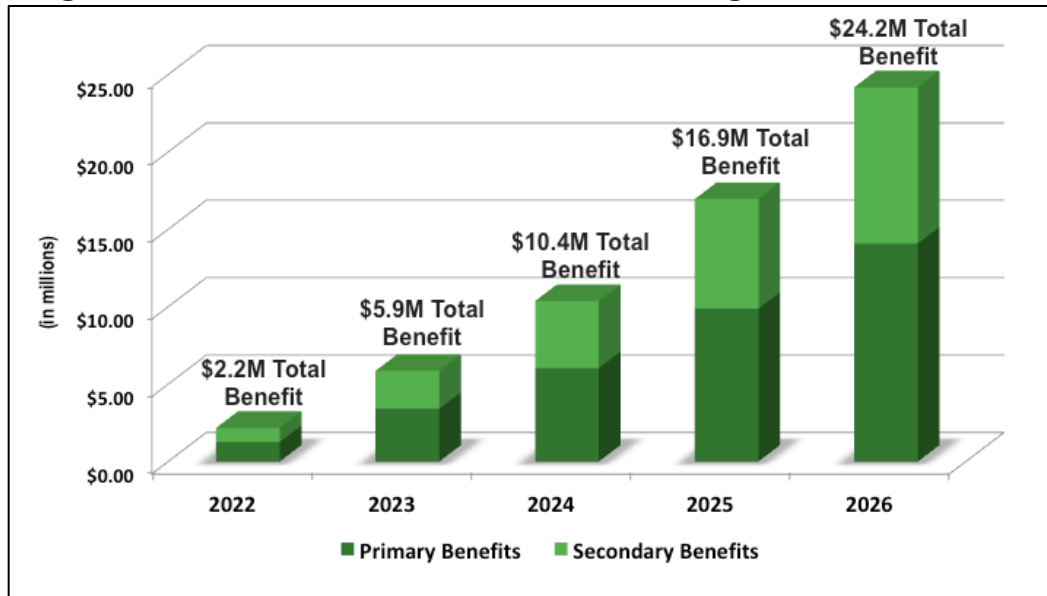
### ***Main Results: Economic Benefits of IVVC Program Initiative***

Figure 1 summarizes the total cumulative economic benefits (primary and secondary) in South Carolina resulting from the IVVC program during the first five years in which customers will experience benefits. Note that these benefits increase over time (between 2022 and 2026) as new infrastructure comes online. In sum, the cumulative economic benefits will total \$24.2 million by the year 2026.<sup>1</sup>

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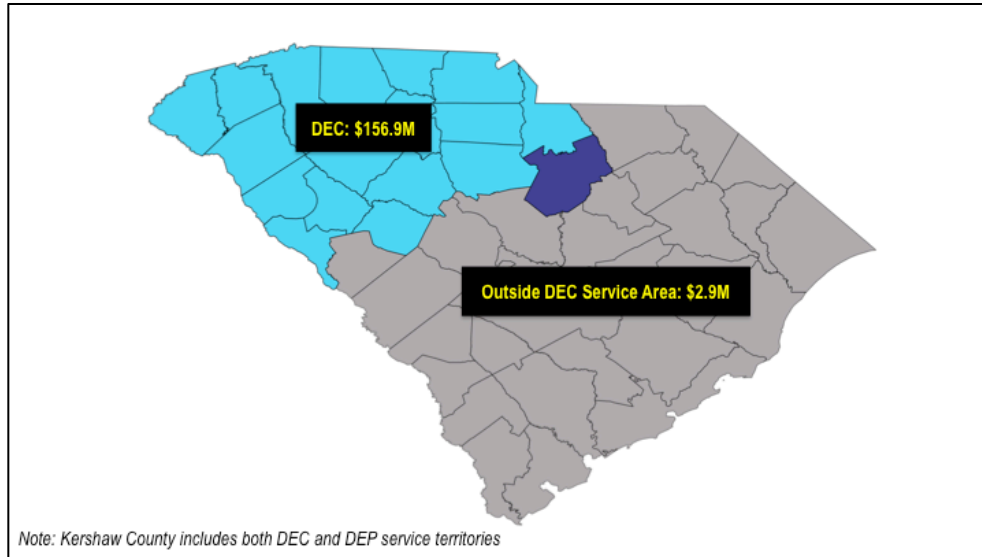
<sup>1</sup> All economic benefits are expressed in current (2019) dollars.

**Figure 1: Cumulative Economic Benefits of IVVC Program in SC: 2022-2026**



The majority of the economic benefits resulting from the South Carolina IVVC program will accrue to counties in which the Duke Energy service territory extends. However, the benefits will not be distributed equally. In addition to the fact that Duke Energy customers are not equally distributed within the service territory, economic benefits resulting from improvements that accrue to Duke Energy customers will also generate economic spillover effects to the surrounding regions. These spillover effects come in the form of both additional spending with vendors/suppliers on the part of non-residential customers and the spending of additional earned wages on the part of residential customers. Not all spending activities on the part of Duke Energy customers take place within the Duke Energy service territory – thus a portion of the total economic benefits resulting from the IVVC program will extend statewide. Figures 2-3 show the regions projected to experience the largest percentage of these economic benefits over time.

**Figure 2: Cumulative Total Economic Benefits of IVVC in S.C. by Service Area**



Approximately 98.1 percent of the total economic benefits associated with the IVVC program are estimated to accrue to the Duke Energy Carolinas (DEC) service territory, which is projected to total approximately \$156.9 million by 2044. The remaining 1.9 percent of the economic benefits will likely accrue to counties outside of the service area (\$2.9 million). ***Thus, the IVVC program is projected to generate nearly \$160 million in total economic benefits for South Carolina during its 25-year benefit period, including \$66.7 million in secondary economic benefits.***

**Figure 3: Cumulative Total Economic Benefits of IVVC in S.C. by County**

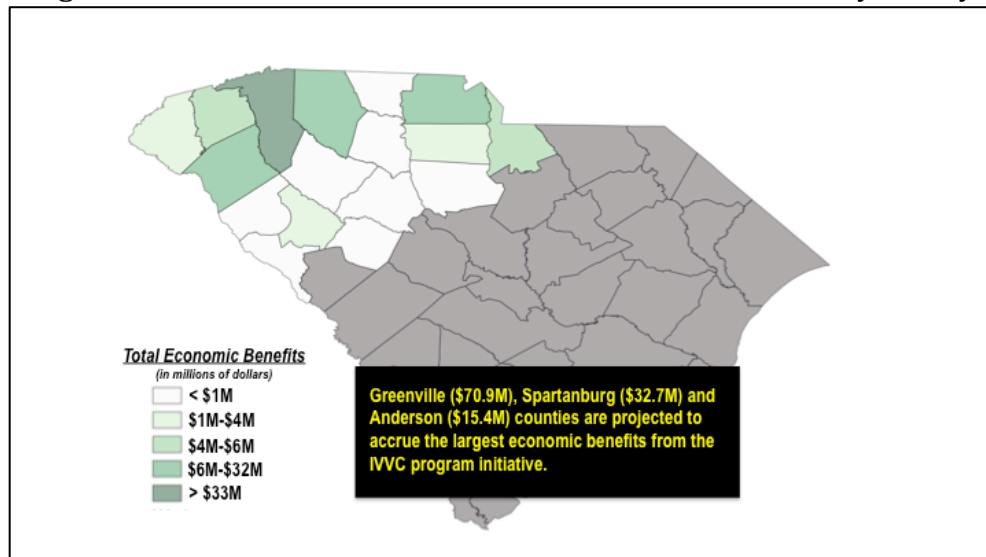


Figure 3 illustrates the breakdown of the total economic benefits associated with the IVVC program initiative by county. Note that Greenville (44.4%), Spartanburg (20.5%), and Anderson (9.7%) counties are projected to experience the largest economic benefits, followed by York (9.2%), Pickens (3.6%), and Lancaster (3.6%).



The high concentration of customers within Greenville, Spartanburg, and Anderson counties is what generates the disproportionately large economic benefits in these regions.

## **Duke Energy Grid Improvement Plan (GIP) Economic Benefits Assessment**

### ***Program: LDI/HIS***

*Prepared by: Joseph Von Nessen, Ph.D.*

*Last Revised: 3/5/19*

### ***Measuring Primary and Secondary Economic Benefits***

Duke Energy estimates that approximately 12,623 South Carolina customers will benefit from the LDI/HIS program initiative throughout its complete 30-year benefit period. Approximately 10,113 (80.1%) of these are residential customers while the remaining 2,510 are non-residential.

In order to determine some of the *primary* economic benefits that are likely to result from this program, Duke Energy's forecasts were combined with data on the number and type of customers that will be affected and then used these data as inputs into the Interruption Cost Estimate Calculator (ICE) developed by the U.S. Department of Energy. The ICE model specifically calculates the average interruption cost for residential, business, and commercial customers using a regression model that takes into account factors such as the duration of the outage, the industry affected, household demographics patterns, and various seasonal factors.<sup>1</sup> By estimating the interruption costs associated with current projections vs. projections that take the LDI/HIS program into account and then subtracting the latter from the former, the annual direct cost savings to impacted customers can be determined.

These direct cost savings, however, do not represent the full economic benefits of the LDI/HIS program. When businesses experience these cost reductions, over time they will begin to expand their economic activities through additional purchases of raw inputs and the hiring of additional employees. These are known as secondary economic benefits. Additional secondary economic benefits will also accrue to a variety of local businesses when residential customers spend wages with these local businesses that they are no longer losing as a result of temporary employer shut downs.

Thus, both *primary* and *secondary* economic benefits are generated as a result of the program that, together, represents the total economic benefits of the LDI/HIS program initiative. To specifically estimate the secondary economic benefits, the *IMPLAN* economic model is used.

### ***Main Results: Economic Benefits of LDI/HIS Program Initiative***

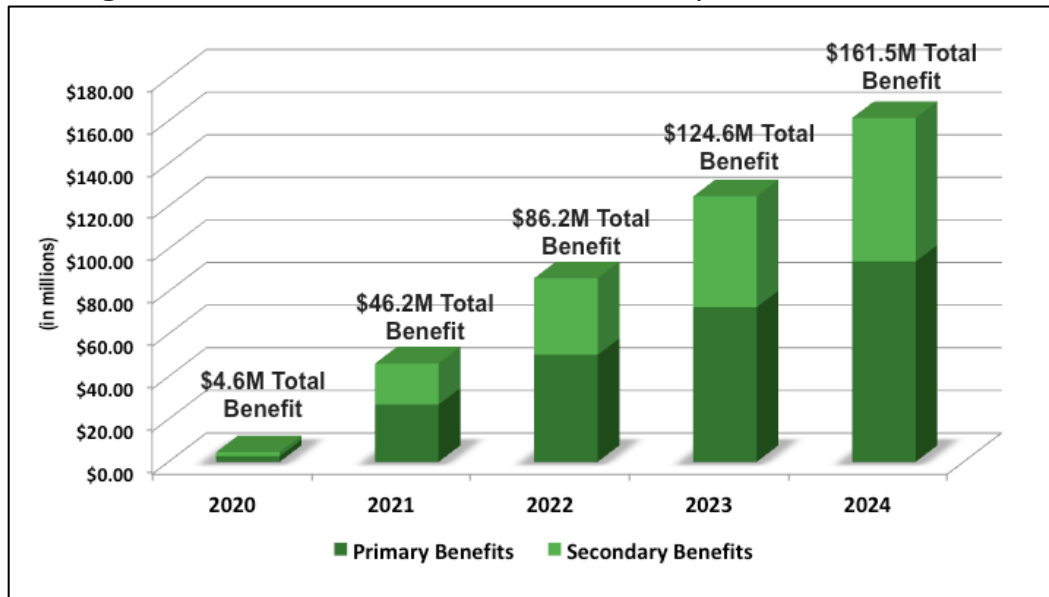
Figure 1 summarizes the total cumulative economic benefits (primary and secondary) in South Carolina resulting from the LDI/HIS program initiative during the first five years in which customers will experience benefits. Note that these benefits increase over time (between 2020 and 2024) as new infrastructure comes

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<sup>1</sup> Additional detailed methodology on the ICE model can be found at <http://icecalculator.com>

online. In sum, the cumulative economic benefits will total \$161.5 million by the year 2024.<sup>2</sup>

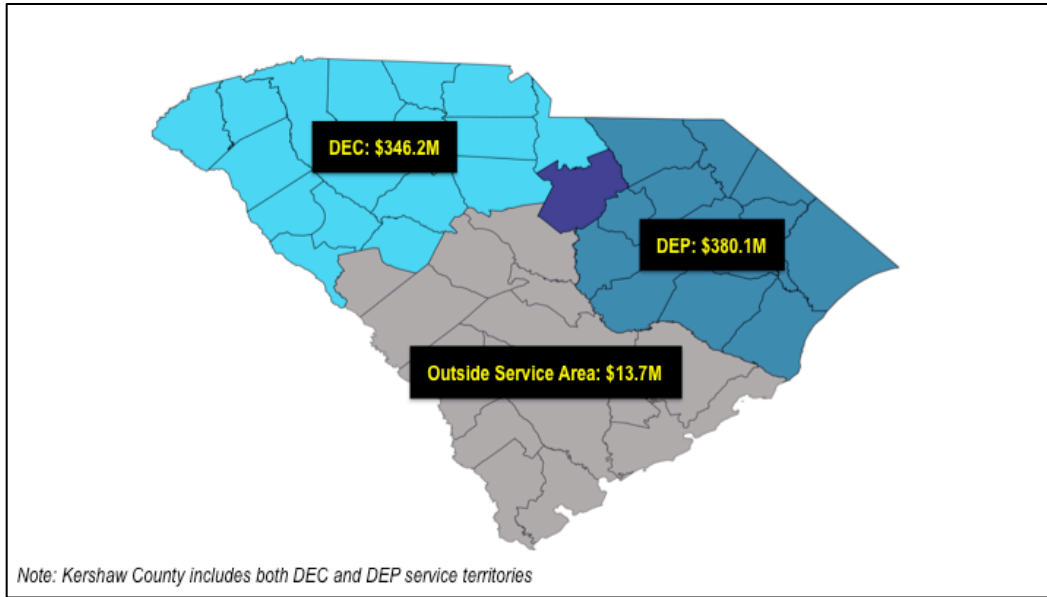
**Figure 1: Cumulative Economic Benefits of LDI/HIS in SC: 2020-2024**



The majority of the economic benefits resulting from the South Carolina LDI/HIS program will accrue to counties in which the Duke Energy service territory extends. However, the benefits will not be distributed equally. In addition to the fact that Duke Energy customers are not equally distributed within the service territory, economic benefits resulting from improvements that accrue to Duke Energy customers will also generate economic spillover effects to the surrounding regions. These spillover effects come in the form of both additional spending with vendors/suppliers on the part of non-residential customers and the spending of additional earned wages on the part of residential customers. Not all spending activities on the part of Duke Energy customers take place within the Duke Energy service territory – thus a portion of the total economic benefits resulting from LDI/HIS improvements will extend statewide. Figures 2-3 show the regions projected to experience the largest percentage of these economic benefits over time.

<sup>2</sup> All economic benefits are expressed in current (2019) dollars.

**Figure 2: Cumulative Total Economic Benefits of LDI/HIS in S.C. by Service Area**



Approximately 46.8 percent of the total economic benefits associated with the LDI/HIS program initiative are estimated to accrue to the Duke Energy Carolinas (DEC) service territory, which is projected to total approximately \$346.2 million by 2049. Roughly 51.4 percent of the total benefits are estimated to accrue to counties within the Duke Energy Progress (DEP) service territory (\$380.1 million), while the remaining 1.9 percent of the economic benefits will likely accrue to counties outside of the service area (\$13.7 million). ***Thus, the LDI/HIS program initiative is projected to generate more than \$740 million in total economic benefits for South Carolina during its 30-year benefit period, including \$308.9 million in secondary economic benefits.***

**Figure 3: Cumulative Total Economic Benefits of LDI/HIS in S.C. by County**

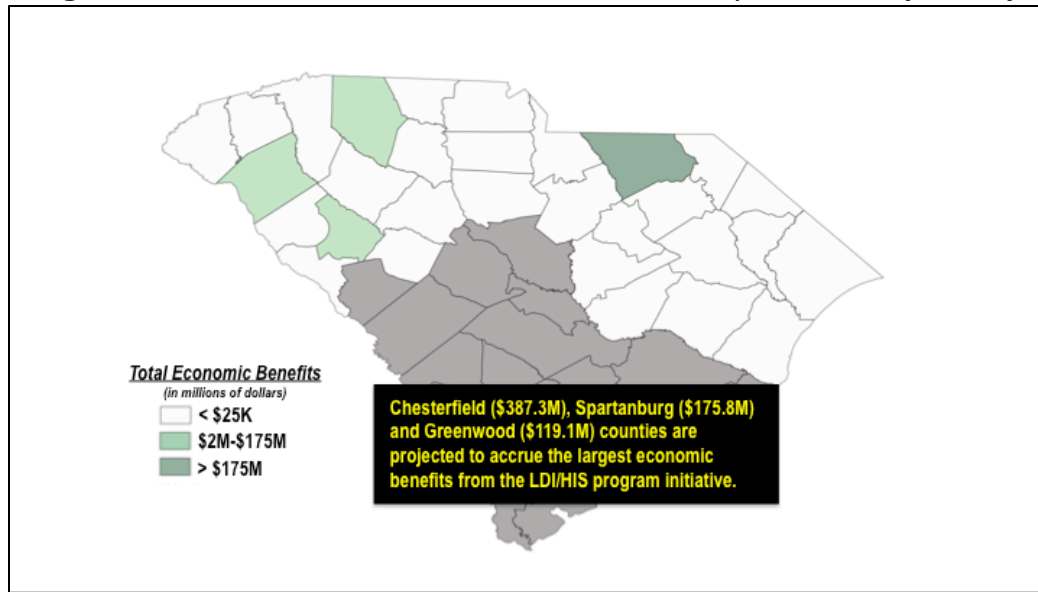


Figure 2 illustrates the breakdown of the total economic benefits associated with the LDI/HIS program initiative by county. Note that Chesterfield (52.3%), Spartanburg (23.8%), and Greenwood (16.1%) counties are projected to experience the largest economic benefits.

The primary and secondary economic benefits of the LDI/HIS program initiative in South Carolina can also be broken down by project. These individual estimates are displayed in Table 1.

**Table 1: Cumulative Total Economic Benefits of LDI/HIS in S.C. by Project**

Project Title	Primary Benefits	Secondary Benefits	Total Benefits
Cheraw River Crossing	\$225,648,390	\$161,654,394	\$387,302,784
Brushy Creek	\$13,241	\$9,486	\$22,727
Whitehall Hurricane Creek	\$8,559,373	\$6,131,930	\$14,691,303
Whitehall Sandy Springs	\$22,996,612	\$16,474,761	\$39,471,373
Fants Grove	\$2,148,633	\$1,539,280	\$3,687,913
Moore Camp Croft	\$21,668,393	\$15,523,226	\$37,191,618
Moore Woodruff	\$80,769,639	\$57,863,329	\$138,632,968
Eddy Road Panorama	\$69,387,572	\$49,709,222	\$119,096,794
<b>Totals</b>	<b>\$431,191,852</b>	<b>\$308,905,628</b>	<b>\$740,097,480</b>

## **Duke Energy Grid Improvement Plan (GIP) Economic Benefits Assessment**

### ***Program: Self-Optimizing Grid (SOG)***

*Prepared by: Joseph Von Nessen, Ph.D.*

*Last Revised: 3/5/19*

### ***Measuring Primary and Secondary Economic Benefits***

Duke Energy estimates that approximately 249,652 South Carolina customers will benefit from the SOG program initiative throughout its complete 20-year benefit period. Approximately 219,382 (87.9%) of these are residential customers while the remaining 30,270 are non-residential. As part of the SOG program, upgrades will be made to 119 South Carolina-based substations.

In order to determine some of the *primary* economic benefits that are likely to result from this program, Duke Energy's forecasts were combined with data on the number and type of customers that will be affected and then used these data as inputs into the Interruption Cost Estimate Calculator (ICE) developed by the U.S. Department of Energy. The ICE model specifically calculates the average interruption cost for residential, business, and commercial customers using a regression model that takes into account factors such as the duration of the outage, the industry affected, household demographics patterns, and various seasonal factors.<sup>1</sup> By estimating the interruption costs associated with current projections vs. projections that take the SOG program into account and then subtracting the latter from the former, the annual direct cost savings to impacted customers can be determined.

These direct cost savings, however, do not represent the full economic benefits of the SOG program. When businesses experience these cost reductions, over time they will begin to expand their economic activities through additional purchases of raw inputs and the hiring of additional employees. These are known as secondary economic benefits. Additional secondary economic benefits will also accrue to a variety of local businesses when residential customers spend wages with these local businesses that they are no longer losing as a result of temporary employer shut downs.

Thus, both *primary* and *secondary* economic benefits are generated as a result of the program that, together, represents the total economic benefits of the SOG program initiative. To specifically estimate the secondary economic benefits, the *IMPLAN* economic model is used.

### ***Main Results: Economic Benefits of SOG Program Initiative***

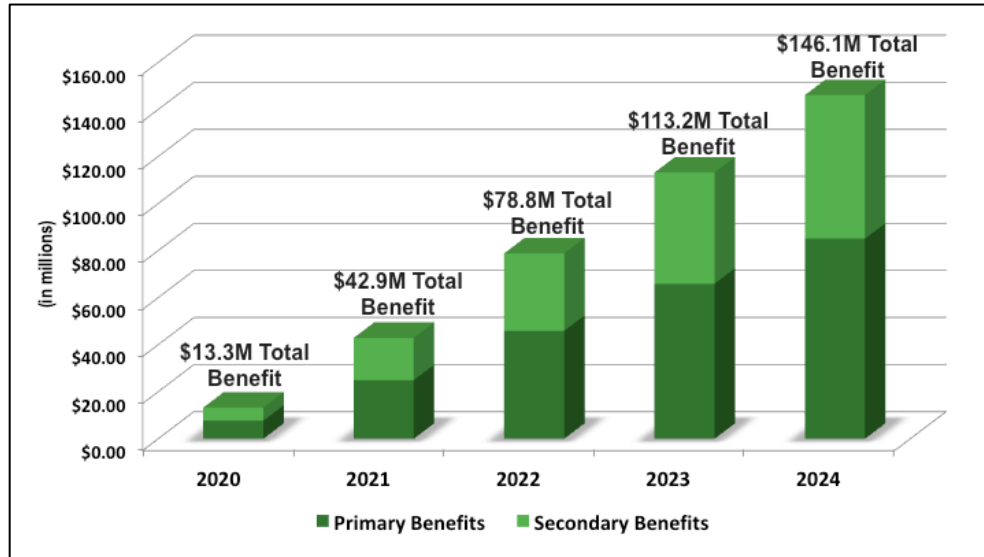
Figure 1 summarizes the total cumulative economic benefits (primary and secondary) in South Carolina resulting from SOG upgrades during the first five years in which customers will experience benefits. Note that these benefits increase over

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<sup>1</sup> Additional detailed methodology on the ICE model can be found at <http://icecalculator.com>

time (between 2020 and 2024) as new infrastructure comes online. In sum, the cumulative economic benefits will total \$146.1 million by the year 2024.<sup>2</sup>

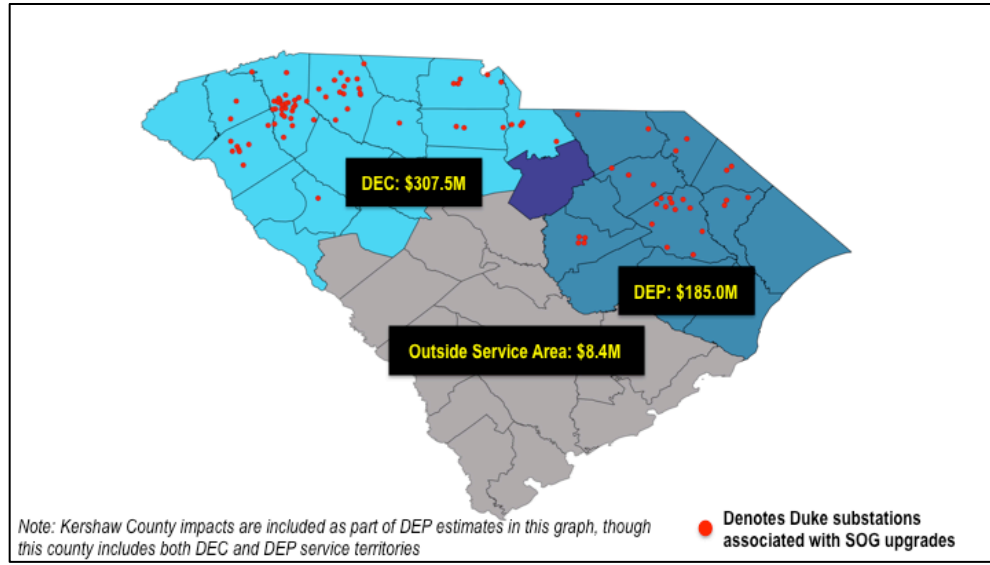
**Figure 1: Cumulative Economic Benefits of SOG Upgrade in SC: 2020-2024**



The majority of the economic benefits resulting from the South Carolina SOG upgrades will accrue to counties in which the Duke Energy service territory extends. However, the benefits will not be distributed equally. In addition to the fact that Duke Energy customers are not equally distributed within the service territory, economic benefits resulting from improvements that accrue to Duke Energy customers will also generate economic spillover effects to the surrounding regions. These spillover effects come in the form of both additional spending with vendors/suppliers on the part of non-residential customers and the spending of additional earned wages on the part of residential customers. Not all spending activities on the part of Duke Energy customers take place within the Duke Energy service territory – thus a portion of the total economic benefits resulting from SOG improvements will extend statewide. Figures 2-3 show the regions projected to experience the largest percentage of these economic benefits over time.

<sup>2</sup> All economic benefits are expressed in current (2019) dollars.

**Figure 2: Cumulative Total Economic Benefits of SOG in S.C. by Service Area**



Approximately 61.4 percent of the total economic benefits associated with the SOG upgrades are estimated to accrue to the Duke Energy Carolinas (DEC) service territory, which is projected to total approximately \$307.5 million by 2039. Roughly 36.9 percent of the total benefits are estimated to accrue to counties within the Duke Energy Progress (DEP) service territory (\$185.0 million), while the remaining 1.7 percent of the economic benefits will likely accrue to counties outside of the service area (\$8.4 million). ***Thus, SOG improvements are projected to generate nearly \$501 million in total economic benefits for South Carolina during its 20-year benefit period, including \$208.9 million in secondary economic benefits.***

**Figure 3: Cumulative Total Economic Benefits of SOG in S.C. by County**

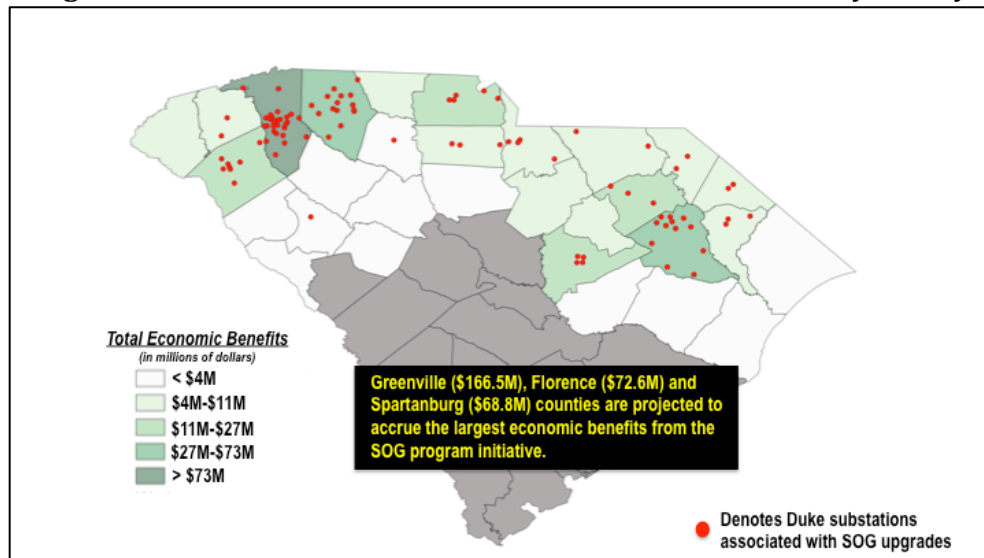


Figure 3 illustrates the breakdown of the total economic benefits associated with the SOG program initiative by county. Note that Greenville (33.2%), Florence



(14.5%), and Spartanburg (13.7%) counties are projected to experience the largest economic benefits, followed by Sumter (5.4%), York (4.4%), and Anderson (4.0%). The high concentration of customers within Greenville, Florence, and Spartanburg counties is what generates the disproportionately large economic benefits in these regions.

## **Duke Energy Grid Improvement Plan (GIP) Economic Benefits Assessment**

### ***Program: Transmission 44kV***

*Prepared by: Joseph Von Nessen, Ph.D.*

*Last Revised: 3/5/19*

### ***Measuring Primary and Secondary Economic Benefits***

In order to determine some of the *primary* economic benefits that are likely to result from this program, Duke Energy's forecasts were combined with data on the number and type of customers that will be affected and then used these data as inputs into the Interruption Cost Estimate Calculator (ICE) developed by the U.S. Department of Energy. The ICE model specifically calculates the average interruption cost for residential, business, and commercial customers using a regression model that takes into account factors such as the duration of the outage, the industry affected, household demographics patterns, and various seasonal factors.<sup>1</sup> By estimating the interruption costs associated with current projections vs. projections that take the Transmission 44kV program into account and then subtracting the latter from the former, the annual direct cost savings to impacted customers can be determined.

These direct cost savings, however, do not represent the full economic benefits of the Transmission 44kV program. When businesses experience these cost reductions, over time they will begin to expand their economic activities through additional purchases of raw inputs and the hiring of additional employees. These are known as secondary economic benefits. Additional secondary economic benefits will also accrue to a variety of local businesses when residential customers spend wages with these local businesses that they are no longer losing as a result of temporary employer shut downs.

Thus, both *primary* and *secondary* economic benefits are generated as a result of the program that, together, represents the total economic benefits of the Transmission 44kV program initiative. To specifically estimate the secondary economic benefits, the *IMPLAN* economic model is used.

### ***Main Results: Economic Benefits of Transmission 44kV Program Initiative***

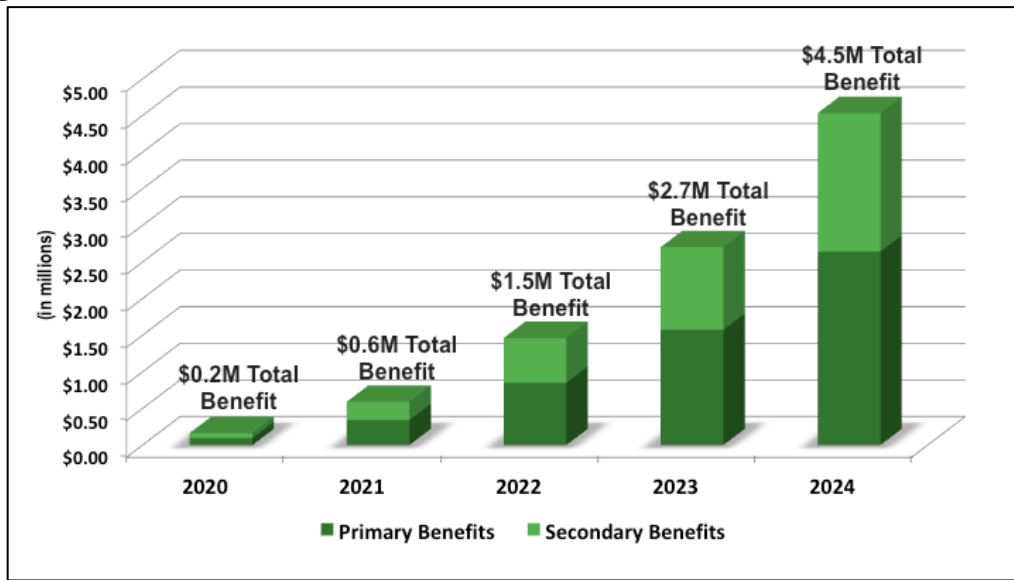
Figure 1 summarizes the total cumulative economic benefits (primary and secondary) in South Carolina resulting from the Transmission 44kV program initiative during the first five years in which customers will experience benefits. Note that these benefits increase over time (between 2020 and 2024) as new infrastructure comes online. In sum, the cumulative economic benefits will total \$4.5 million by the year 2024.<sup>2</sup>

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<sup>1</sup> Additional detailed methodology on the ICE model can be found at <http://icecalculator.com>

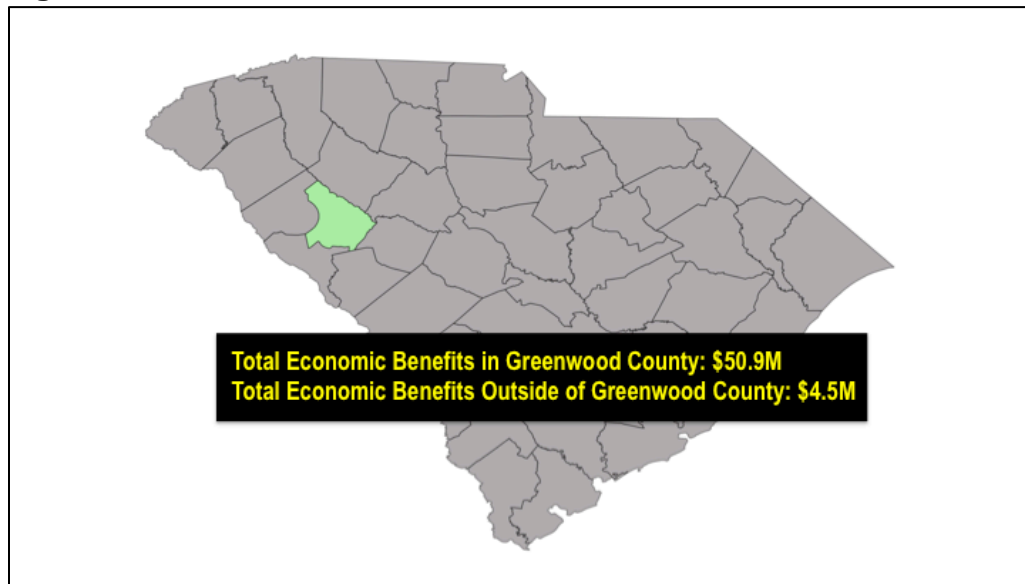
<sup>2</sup> All economic benefits are expressed in current (2019) dollars.

**Figure 1: Cumulative Economic Benefits of Transmission 44kV in SC: 2020-2024**



The Transmission 44kV Program Initiative will include projects based in both North and South Carolina. Because the only South Carolina-based project within the Transmission 44kV program initiative will be undertaken in Greenwood County, the majority of the South Carolina economic benefits resulting from Transmission 44kV will accrue to Greenwood County. Nevertheless, the economic benefits resulting from both North and South Carolina improvements that accrue to Duke Energy customers will also generate economic spillover effects to the surrounding regions. These spillover effects come in the form of both additional spending with vendors/suppliers on the part of non-residential customers and the spending of additional earned wages on the part of residential customers. Figure 2 highlights the total economic benefits that will occur in South Carolina as a result of the Transmission 44kV program initiative over time – including the primary and secondary benefits from the Greenwood County project as well as the secondary benefits from North Carolina-based projects.

**Figure 2: Cumulative Total Economic Benefits of Transmission 44kV in S.C.**



Approximately 91.8 percent of the total economic benefits associated with the Transmission 44kV program initiative are estimated to accrue in Greenwood County, which is projected to total approximately \$50.9 million by 2049. Roughly 8.2 percent, or about \$4.5 million, will accrue elsewhere in South Carolina. ***Thus, Transmission 44kV improvements are projected to generate more than \$55.4 million in total economic benefits for South Carolina during its 30-year benefit period, including \$25.8 million in secondary economic benefits.***

The primary and secondary economic benefits of the Transmission 44kV program initiative in South Carolina can also be broken down by project. These individual estimates are displayed in Table 1.

**Table 1: Cumulative Total Economic Benefits of Trans. 44kV in S.C. by Project**

Project Title	Primary Benefits	Secondary Benefits	Total Benefits
Belfast	\$29,663,867	\$21,251,179	\$50,915,046
Spurrier	\$0	\$351,187	\$351,187
Capps-Hendersonville	\$0	\$721,709	\$721,709
Quebec	\$0	\$965,995	\$965,995
Rockford	\$0	\$32,023	\$32,023
Cabin Creek-Stevens	\$0	\$376,781	\$376,781
Spindale	\$0	\$318,023	\$318,023
Hendersonville Main	\$0	\$912,780	\$912,780
Rockford - Level Cr	\$0	\$426,297	\$426,297
Spindale - Fairview	\$0	\$426,659	\$426,659
Duke Univ. Underground	\$0	\$13,362	\$13,362
<b>Totals</b>	<b>\$29,663,867</b>	<b>\$25,795,995</b>	<b>\$55,459,862</b>

## **Duke Energy Grid Improvement Plan (GIP) Economic Benefits Assessment**

### **Program: Transmission Flooded Substation (TFS)**

*Prepared by: Joseph Von Nessen, Ph.D.*

*Last Revised: 3/5/19*

#### **Measuring Primary and Secondary Economic Benefits**

In order to determine some of the *primary* economic benefits that are likely to result from this program, Duke Energy's forecasts were combined with data on the number and type of customers that will be affected and then used these data as inputs into the Interruption Cost Estimate Calculator (ICE) developed by the U.S. Department of Energy. The ICE model specifically calculates the average interruption cost for residential, business, and commercial customers using a regression model that takes into account factors such as the duration of the outage, the industry affected, household demographics patterns, and various seasonal factors.<sup>1</sup> By estimating the interruption costs associated with current projections vs. projections that take the TFS program into account and then subtracting the latter from the former, the annual direct cost savings to impacted customers can be determined.

These direct cost savings, however, do not represent the full economic benefits of the TFS program. When businesses experience these cost reductions, over time they will begin to expand their economic activities through additional purchases of raw inputs and the hiring of additional employees. These are known as secondary economic benefits. Additional secondary economic benefits will also accrue to a variety of local businesses when residential customers spend wages with these local businesses that they are no longer losing as a result of temporary employer shut downs.

Thus, both *primary* and *secondary* economic benefits are generated as a result of the program that, together, represents the total economic benefits of the TFS program initiative. To specifically estimate the secondary economic benefits, the *IMPLAN* economic model is used.

#### **Main Results: Economic Benefits of TFS Program Initiative**

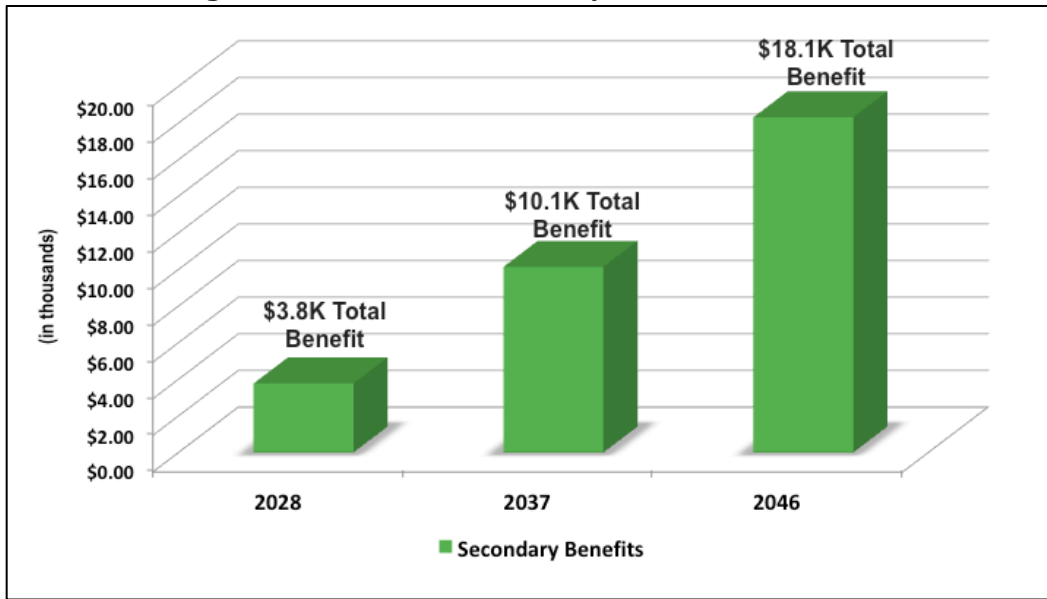
Figure 1 summarizes the total secondary economic benefits in South Carolina resulting from the TFS program initiative throughout its 30-year benefits period. Note that these benefits increase over time as new infrastructure comes online. In sum, the cumulative secondary economic benefits will total approximately \$18.1 thousand by the year 2046.<sup>2</sup>

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<sup>1</sup> Additional detailed methodology on the ICE model can be found at <http://icecalculator.com>

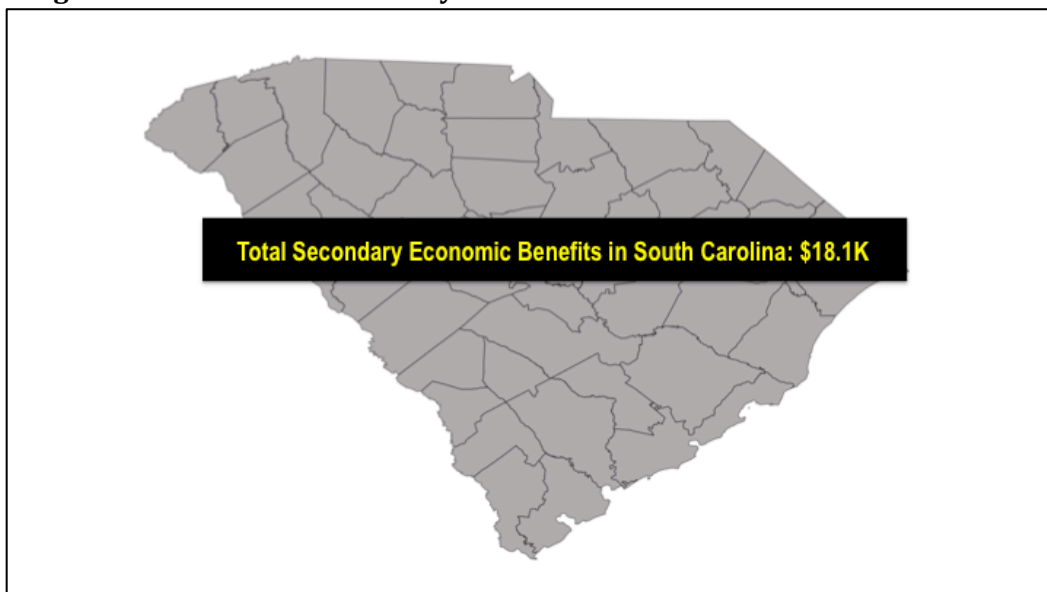
<sup>2</sup> All economic benefits are expressed in current (2019) dollars.

**Figure 1: Cumulative Secondary Benefits of TFS in SC**



The majority of the economic benefits resulting from the TFS program initiative will accrue to counties in North Carolina because each of the five projects that are part of the TFS program will take place there. Nevertheless, the economic benefits resulting from improvements that accrue to Duke Energy customers will also generate economic spillover effects to the surrounding regions – including South Carolina. These spillover effects come in the form of both additional spending with vendors/suppliers on the part of non-residential customers and the spending of additional earned wages on the part of residential customers. Figure 2 highlights the economic spillover effects that will occur in South Carolina as a result of the TFS program initiative over time.

**Figure 2: Cumulative Secondary Economic Benefits of TFS in South Carolina**



Approximately 98.9 percent of the total economic benefits associated with the TFS program initiative are estimated to accrue in North Carolina, which is projected to total approximately \$1.6 million by 2049. Roughly 1.1 percent, or about \$18.1K in secondary economic benefits, will accrue to counties in South Carolina. ***Thus, TFS improvements are projected to generate approximately \$18.1K in secondary economic benefits for South Carolina during its 30-year benefit period.***

The secondary economic benefits of the TFS program initiative in South Carolina can also be broken down by project. These individual estimates are displayed in Table 1.

**Table 1: Cumulative Secondary Economic Benefits of TFS in S.C. by Project**

<b>Project Title</b>	<b>Secondary Benefits</b>
Whiteville	\$4,180
Goldsboro Weil	\$1,270
Grifton	\$2,121
Greenville	\$10,510
Lee Steam Electric Plant	\$0
<b>Totals</b>	<b>\$18,081</b>

## **Duke Energy Grid Improvement Plan (GIP) Economic Benefits Assessment**

### ***Program: Transmission Line Rebuilds (TLR)***

*Prepared by: Joseph Von Nessen, Ph.D.*

*Last Revised: 3/5/19*

### ***Measuring Primary and Secondary Economic Benefits***

In order to determine some of the primary economic benefits that are likely to result from this program, Duke Energy's forecasts were combined with data on the number and type of customers that will be affected and then used these data as inputs into the Interruption Cost Estimate Calculator (ICE) developed by the U.S. Department of Energy. The ICE model specifically calculates the average interruption cost for residential, business, and commercial customers using a regression model that takes into account factors such as the duration of the outage, the industry affected, household demographics patterns, and various seasonal factors.<sup>1</sup> By estimating the interruption costs associated with current projections vs. projections that take the Transmission Line Rebuilds (TLR) program into account and then subtracting the latter from the former, the annual direct cost savings to impacted customers can be determined.

These direct cost savings, however, do not represent the full economic benefits of the TLR program. When businesses experience these cost reductions, over time they will begin to expand their economic activities through additional purchases of raw inputs and the hiring of additional employees. These are known as secondary economic benefits. Additional secondary economic benefits will also accrue to a variety of local businesses when residential customers spend wages with these local businesses that they are no longer losing as a result of temporary employer shut downs.

Thus, both primary and secondary economic benefits are generated as a result of the program that, together, represents the total economic benefits of the TLR program initiative. To specifically estimate the secondary economic benefits, the *IMPLAN* economic model is used.

### ***Main Results: Economic Benefits of TLR Program Initiative***

Figure 1 summarizes the total cumulative economic benefits (primary and secondary) in South Carolina resulting from the TLR program initiative during the first five years in which customers will experience benefits. Note that these benefits increase over time (between 2019 and 2023) as new infrastructure comes online. In sum, the cumulative economic benefits will total \$59.7 thousand by the year 2023.<sup>2</sup>

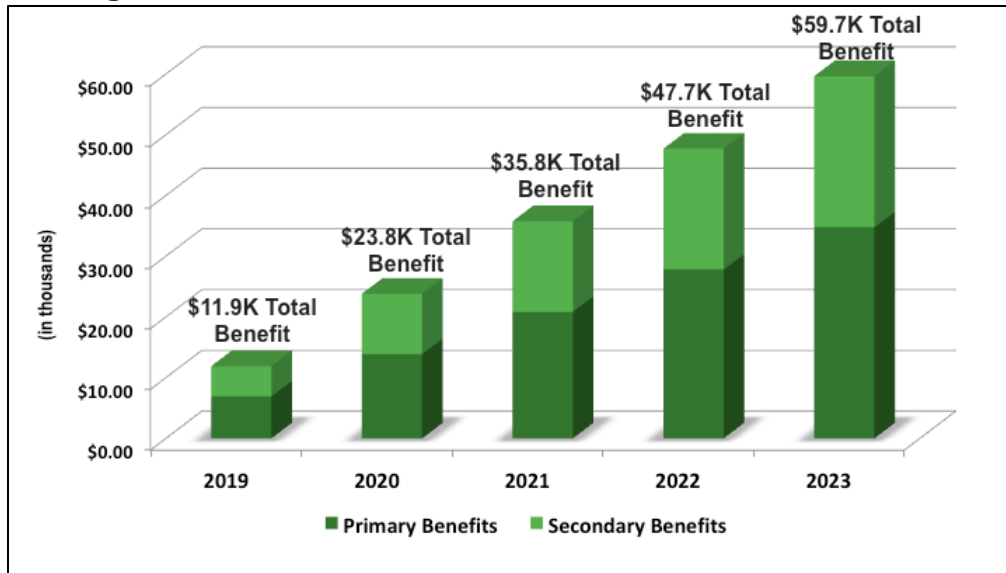
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<sup>1</sup> Additional detailed methodology on the ICE model can be found at <http://icecalculator.com>

<sup>2</sup> All economic benefits are expressed in current (2019) dollars.

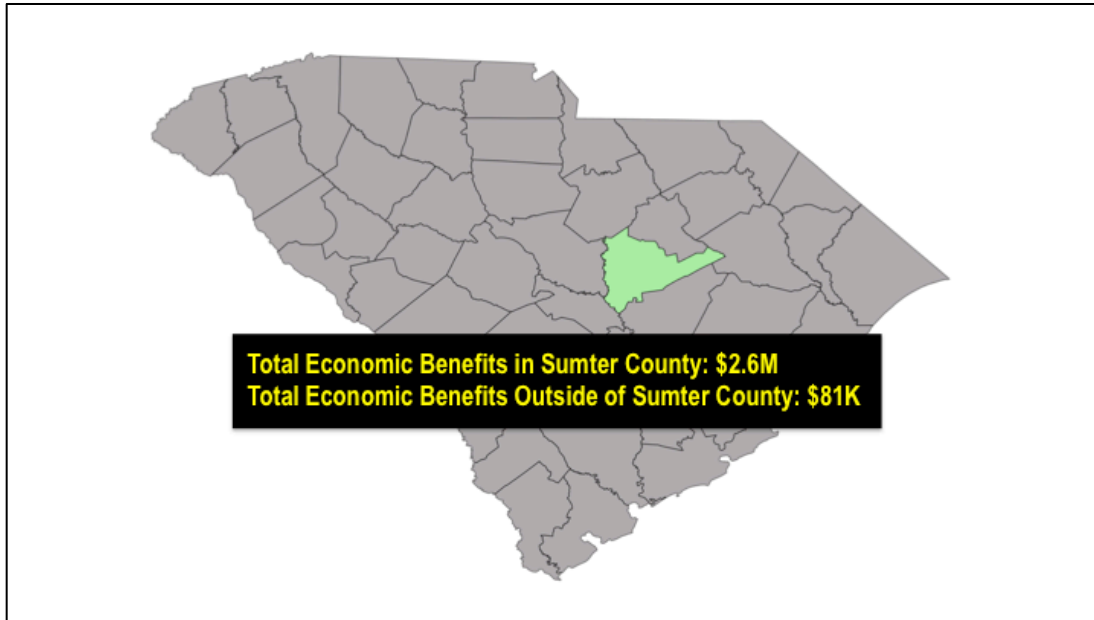


**Figure 1: Cumulative Economic Benefits of TLR in SC: 2019-2023**



The TLF Program Initiative will include projects based in both North and South Carolina. Because the only South Carolina-based project within the TLR program initiative will be undertaken in Sumter County, the majority of the South Carolina economic benefits resulting from TLR will accrue to Sumter County. Nevertheless, the economic benefits resulting from both North and South Carolina improvements that accrue to Duke Energy customers will also generate economic spillover effects to the surrounding regions. These spillover effects come in the form of both additional spending with vendors/suppliers on the part of non-residential customers and the spending of additional earned wages on the part of residential customers. Figure 2 highlights the total economic benefits that will occur in South Carolina as a result of the TLR program initiative over time – including the primary and secondary benefits from the Sumter County project as well as the secondary benefits from North Carolina-based projects.

**Figure 2: Cumulative Total Economic Benefits of TLR in South Carolina**



Approximately 96.9 percent of the total economic benefits associated with the TLR program initiative are estimated to accrue in Sumter County, which is projected to total approximately \$2.6 million by 2049. Roughly 3.1 percent, or about \$81K, will accrue elsewhere in South Carolina. ***Thus, TLR improvements are projected to generate more than \$2.6 million in total economic benefits for South Carolina during its 30-year benefit period, including \$1.1 million in secondary economic benefits.***

The primary and secondary economic benefits of the TLR program initiative in South Carolina can also be broken down by project. These individual estimates are displayed in Table 1.

**Table 1: Cumulative Total Economic Benefits of TLR in S.C. by Project**

Project Title	Primary Benefits	Secondary Benefits	Total Benefits
Sumter	\$1,488,528	\$1,066,381	\$2,554,909
Folkstone-Jacksonville	\$0	\$63,491	\$63,491
Weatherspoon-Raeford	\$0	\$17,141	\$17,141
<b>Totals</b>	<b>\$1,488,528</b>	<b>\$1,147,013</b>	<b>\$2,635,541</b>

## **Duke Energy Grid Improvement Plan (GIP) Economic Benefits Assessment**

### ***Program: Transmission Oil Breaker Replacements***

*Prepared by: Joseph Von Nessen, Ph.D.*

*Last Revised: 3/5/19*

### ***Measuring Primary and Secondary Economic Benefits***

In order to determine some of the primary economic benefits that are likely to result from this program, Duke Energy's forecasts were combined with data on the number and type of customers that will be affected and then used these data as inputs into the Interruption Cost Estimate Calculator (ICE) developed by the U.S. Department of Energy. The ICE model specifically calculates the average interruption cost for residential, business, and commercial customers using a regression model that takes into account factors such as the duration of the outage, the industry affected, household demographics patterns, and various seasonal factors.<sup>1</sup> By estimating the interruption costs associated with current projections vs. projections that take the Transmission Oil Breaker Replacements (TOBR) program into account and then subtracting the latter from the former, the annual direct cost savings to impacted customers can be determined.

These direct cost savings, however, do not represent the full economic benefits of the TOBR program. When businesses experience these cost reductions, over time they will begin to expand their economic activities through additional purchases of raw inputs and the hiring of additional employees. These are known as secondary economic benefits. Additional secondary economic benefits will also accrue to a variety of local businesses when residential customers spend wages with these local businesses that they are no longer losing as a result of temporary employer shut downs.

Thus, both primary and secondary economic benefits are generated as a result of the program that, together, represents the total economic benefits of the TOBR program initiative. To specifically estimate the secondary economic benefits, the *IMPLAN* economic model is used.

### ***Main Results: Economic Benefits of the TOBR Program Initiative***

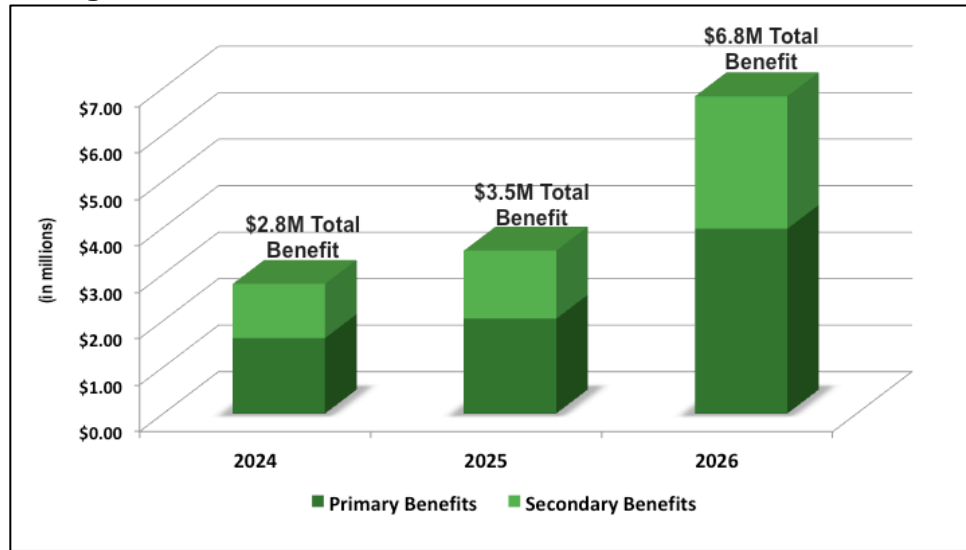
Figure 1 summarizes the total cumulative economic benefits (primary and secondary) in South Carolina resulting from the TOBR program initiative during the first three years in which customers will experience benefits. Note that these benefits increase over time (between 2024 and 2026) as new infrastructure comes online. In sum, the cumulative economic benefits will total \$6.8 million by the year 2026.<sup>2</sup>

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<sup>1</sup> Additional detailed methodology on the ICE model can be found at <http://icecalculator.com>

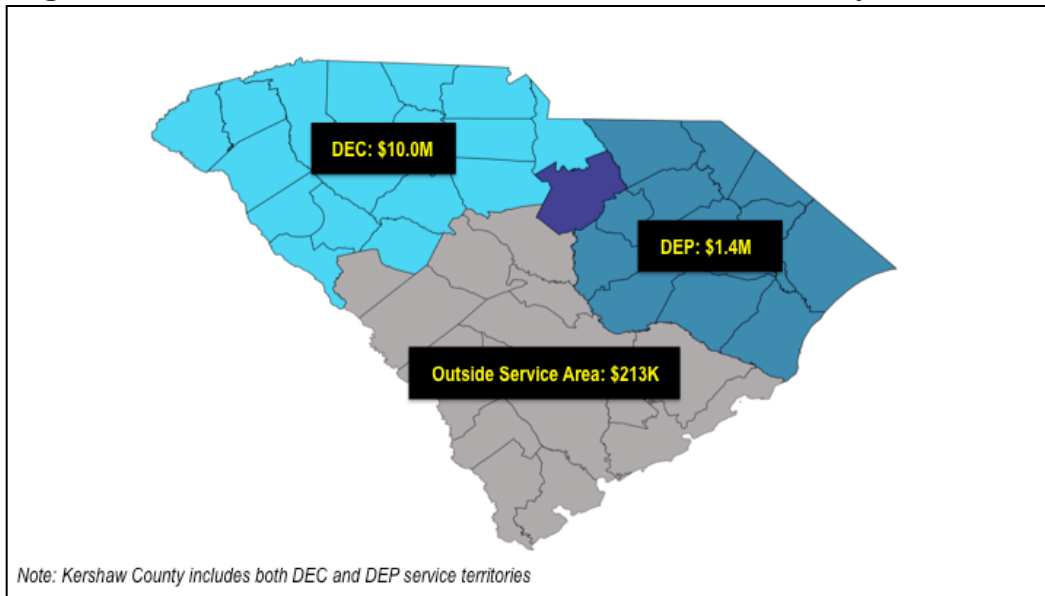
<sup>2</sup> All economic benefits are expressed in current (2019) dollars.

**Figure 1: Cumulative Economic Benefits of TUG in SC: 2024-2026**



The majority of the economic benefits resulting from the South Carolina TOBR program will accrue to counties in which the Duke Energy service territory extends. However, the benefits will not be distributed equally. In addition to the fact that Duke Energy customers are not equally distributed within the service territory, economic benefits resulting from improvements that accrue to Duke Energy customers will also generate economic spillover effects to the surrounding regions. These spillover effects come in the form of both additional spending with vendors/suppliers on the part of non-residential customers and the spending of additional earned wages on the part of residential customers. Not all spending activities on the part of Duke Energy customers take place within the Duke Energy service territory – thus a portion of the total economic benefits resulting from the TOBR program initiative will extend statewide. Figure 2 shows the regions projected to experience the largest percentage of these economic benefits over time.

**Figure 2: Cumulative Total Economic Benefits of TOBR in S.C. by Service Area**



Approximately 86.6 percent of the total economic benefits associated with the TOBR program initiative are estimated to accrue to the Duke Energy Carolinas (DEC) service territory, which is projected to total approximately \$10.0 million by 2049. Roughly 11.6 percent of the total benefits are estimated to accrue to counties within the Duke Energy Progress (DEP) service territory (\$1.4 million), while the remaining 1.8 percent of the economic benefits will likely accrue to counties outside of the service area (\$213K). ***Thus, the Transmission Oil Breaker Replacement Program is projected to generate more than \$11.5 million in total economic benefits for South Carolina during its 30-year benefit period, including \$4.8 million in secondary economic benefits.***

## **Duke Energy Grid Improvement Plan (GIP) Economic Benefits Assessment**

### ***Program: Transformer Retrofit***

*Prepared by: Joseph Von Nessen, Ph.D.*

*Last Revised: 3/5/19*

### ***Measuring Primary and Secondary Economic Benefits***

In order to determine some of the *primary* economic benefits that are likely to result from the Transformer Retrofit program, Duke Energy's forecasts were combined with data on the number and type of customers that will be affected and then used these data as inputs into the Interruption Cost Estimate Calculator (ICE) developed by the U.S. Department of Energy. The ICE model specifically calculates the average interruption cost for residential, business, and commercial customers using a regression model that takes into account factors such as the duration of the outage, the industry affected, household demographics patterns, and various seasonal factors.<sup>1</sup> By estimating the interruption costs associated with current projections vs. projections that take the Transformer Retrofit program into account and then subtracting the latter from the former, the annual direct cost savings to impacted customers can be determined.

These direct cost savings, however, do not represent the full economic benefits of the Transformer Retrofit program. When businesses experience these cost reductions, over time they will begin to expand their economic activities through additional purchases of raw inputs and the hiring of additional employees. These are known as secondary economic benefits. Additional secondary economic benefits will also accrue to a variety of local businesses when residential customers spend wages with these local businesses that they are no longer losing as a result of temporary employer shut downs.

Thus, both *primary* and *secondary* economic benefits are generated as a result of the program that, together, represents the total economic benefits of the Transformer Retrofit program initiative. To specifically estimate the secondary economic benefits, the *IMPLAN* economic model is used.

### ***Main Results: Economic Benefits of Transformer Retrofit Program Initiative***

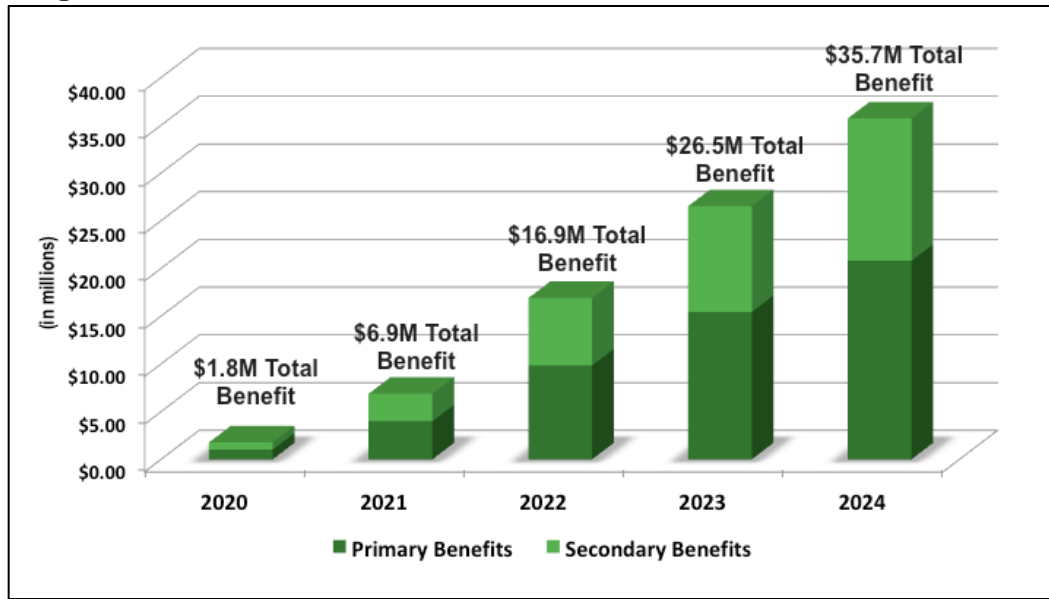
Figure 1 summarizes the total cumulative economic benefits (primary and secondary) in South Carolina resulting from the Transformer Retrofit program initiative during the first five years in which customers will experience benefits. Note that these benefits increase over time (between 2020 and 2024) as new infrastructure comes online. In sum, the cumulative economic benefits will total \$35.7 million by the year 2024.<sup>2</sup>

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<sup>1</sup> Additional detailed methodology on the ICE model can be found at <http://icecalculator.com>

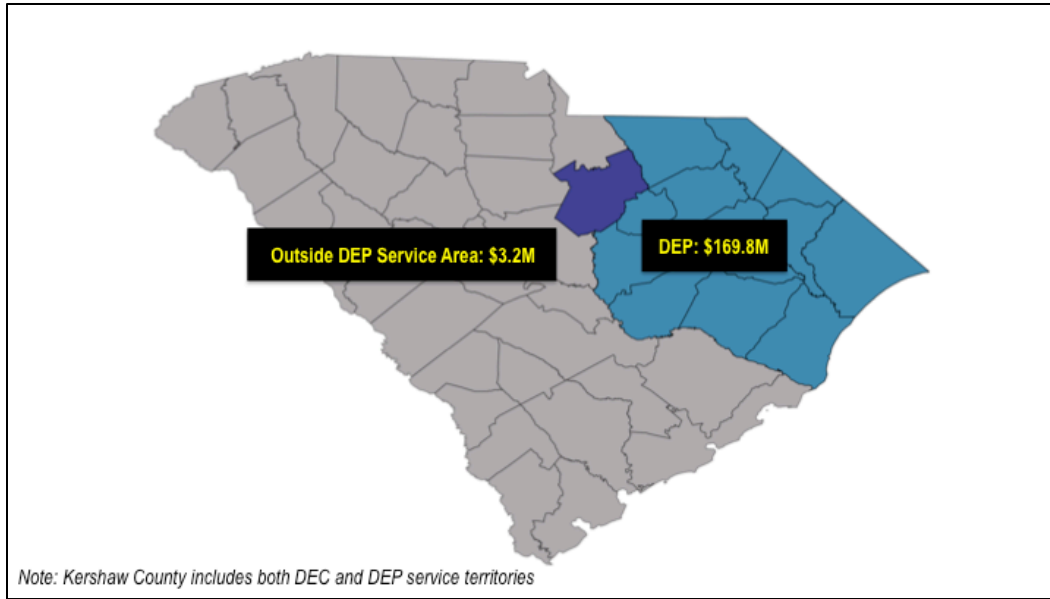
<sup>2</sup> All economic benefits are expressed in current (2019) dollars.

**Figure 1: Cumulative Economic Benefits of Trans. Retrofit in SC: 2020-2024**



The majority of the economic benefits resulting from the South Carolina Transformer Retrofit program will accrue to counties in which the Duke Energy service territory extends. However, the benefits will not be distributed equally. In addition to the fact that Duke Energy customers are not equally distributed within the service territory, economic benefits resulting from improvements that accrue to Duke Energy customers will also generate economic spillover effects to the surrounding regions. These spillover effects come in the form of both additional spending with vendors/suppliers on the part of non-residential customers and the spending of additional earned wages on the part of residential customers. Not all spending activities on the part of Duke Energy customers take place within the Duke Energy service territory – thus a portion of the total economic benefits resulting from Transformer Retrofit improvements will extend statewide. Figures 2-3 show the regions projected to experience the largest percentage of these economic benefits over time.

**Figure 2: Cumulative Total Economic Benefits of Trans. Retrofit in S.C. by Service Area**



Approximately 98.1 percent of the total economic benefits associated with the Transformer Retrofit program are estimated to accrue to the Duke Energy Progress (DEP) service territory, which is projected to total approximately \$169.8 million by 2049. The remaining 1.9 percent of the economic benefits will likely accrue to counties outside of this service area (\$3.2 million). ***Thus, the Transformer Retrofit program is projected to generate nearly \$173 million in total economic benefits for South Carolina during its 30-year benefit period, including \$72.2 million in secondary economic benefits.***



**Figure 3: Cumulative Total Economic Benefits of Trans. Retrofit in S.C. by County**

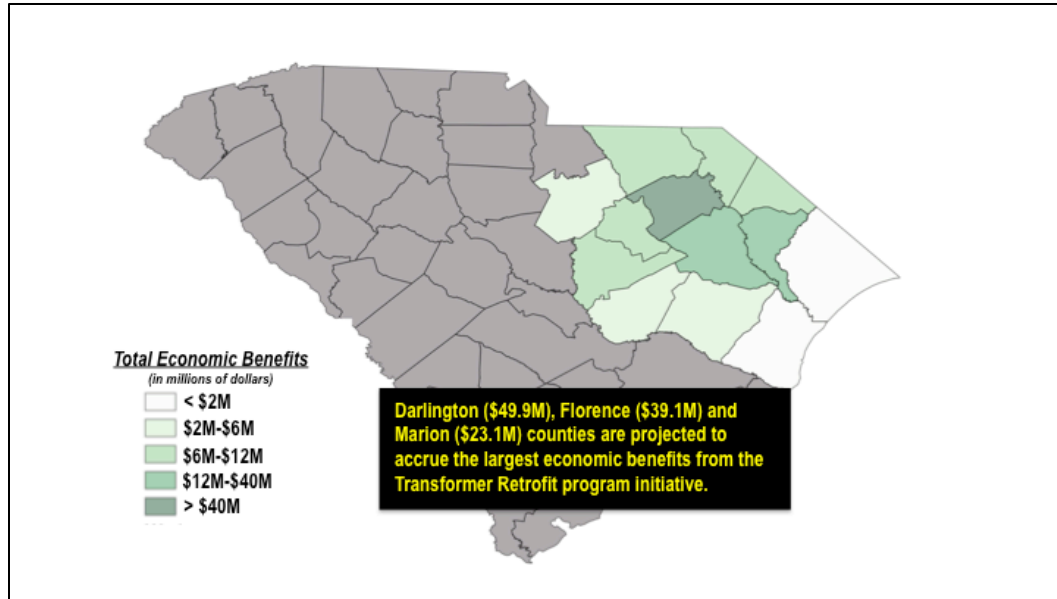


Figure 2 illustrates the breakdown of the total economic benefits associated with the Transformer Retrofit program initiative by county. Note that Darlington (28.8%), Florence (22.6%), and Marion (13.3%) counties are projected to experience the largest economic benefits, followed by Dillon (7.1%), Sumter (5.4%), and Chesterfield (4.2%). The high concentration of customers within Darlington, Florence, and Marion counties is what generates the disproportionately large economic benefits in these regions.

## **Duke Energy Grid Improvement Plan (GIP) Economic Benefits Assessment**

### **Program: Transmission Transformer Bank Replacements**

*Prepared by: Joseph Von Nessen, Ph.D.*

*Last Revised: 3/5/19*

#### **Measuring Primary and Secondary Economic Benefits**

In order to determine some of the *primary* economic benefits that are likely to result from this program, Duke Energy's forecasts were combined with data on the number and type of customers that will be affected and then used these data as inputs into the Interruption Cost Estimate Calculator (ICE) developed by the U.S. Department of Energy. The ICE model specifically calculates the average interruption cost for residential, business, and commercial customers using a regression model that takes into account factors such as the duration of the outage, the industry affected, household demographics patterns, and various seasonal factors.<sup>1</sup> By estimating the interruption costs associated with current projections vs. projections that take the Transmission Transformer Bank Replacements (TTBR) program into account and then subtracting the latter from the former, the annual direct cost savings to impacted customers can be determined.

These direct cost savings, however, do not represent the full economic benefits of the TTBR program. When businesses experience these cost reductions, over time they will begin to expand their economic activities through additional purchases of raw inputs and the hiring of additional employees. These are known as secondary economic benefits. Additional secondary economic benefits will also accrue to a variety of local businesses when residential customers spend wages with these local businesses that they are no longer losing as a result of temporary employer shut downs.

Thus, both *primary* and *secondary* economic benefits are generated as a result of the program that, together, represents the total economic benefits of the TTBR program initiative. To specifically estimate the secondary economic benefits, the *IMPLAN* economic model is used.

#### **Main Results: Economic Benefits of the TTBR Program Initiative**

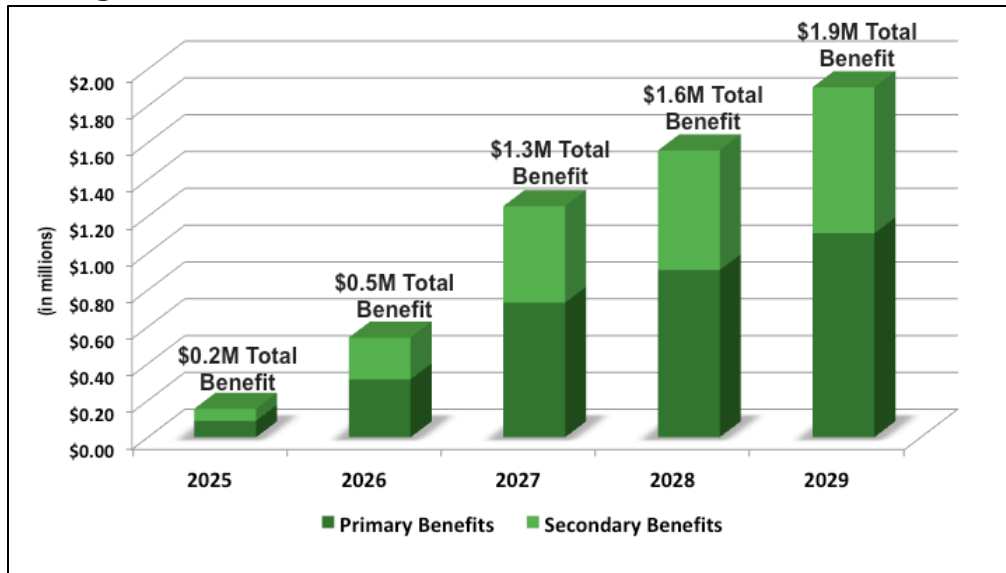
Figure 1 summarizes the total cumulative economic benefits (primary and secondary) in South Carolina resulting from the TTBR program initiative during the first five years in which customers will experience benefits. Note that these benefits increase over time (between 2025 and 2029) as new infrastructure comes online. In sum, the cumulative economic benefits will total \$1.9 million by the year 2029.<sup>2</sup>

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<sup>1</sup> Additional detailed methodology on the ICE model can be found at <http://icecalculator.com>

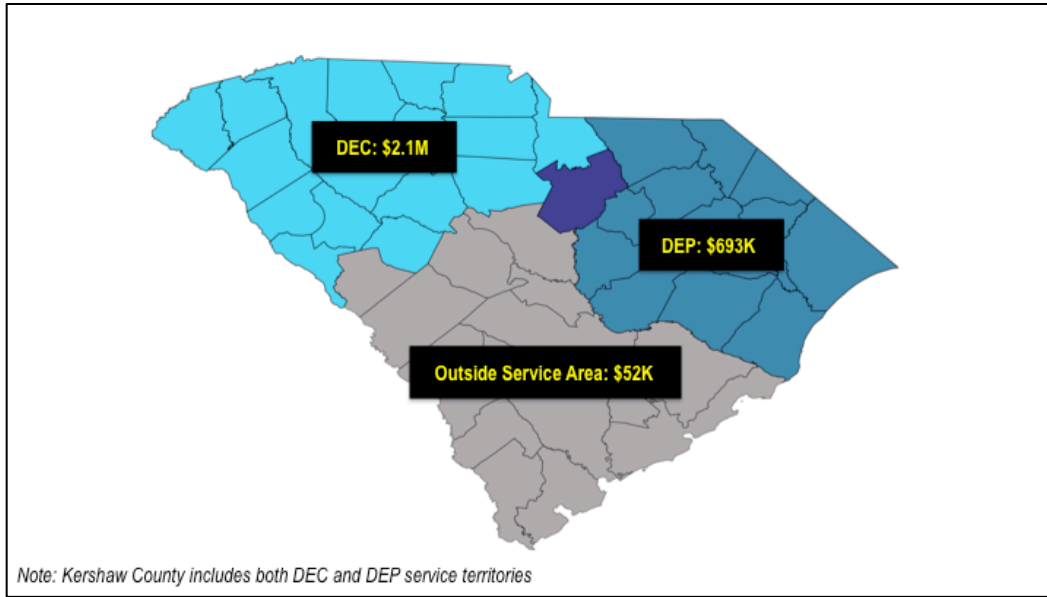
<sup>2</sup> All economic benefits are expressed in current (2019) dollars.

**Figure 1: Cumulative Economic Benefits of TTBR in SC: 2025-2029**



The majority of the economic benefits resulting from the South Carolina TTBR program will accrue to counties in which the Duke Energy service territory extends. However, the benefits will not be distributed equally. In addition to the fact that Duke Energy customers are not equally distributed within the service territory, economic benefits resulting from improvements that accrue to Duke Energy customers will also generate economic spillover effects to the surrounding regions. These spillover effects come in the form of both additional spending with vendors/suppliers on the part of non-residential customers and the spending of additional earned wages on the part of residential customers. Not all spending activities on the part of Duke Energy customers take place within the Duke Energy service territory – thus a portion of the total economic benefits resulting from the TTBR program initiative will extend statewide. Figure 2 shows the regions projected to experience the largest percentage of these economic benefits over time.

**Figure 2: Cumulative Total Economic Benefits of TTBR in S.C. by Service Area**



Approximately 73.5 percent of the total economic benefits associated with the TTBR program initiative are estimated to accrue to the Duke Energy Carolinas (DEC) service territory, which is projected to total approximately \$2.1 million by 2049. Roughly 24.7 percent of the total benefits are estimated to accrue to counties within the Duke Energy Progress (DEP) service territory (\$693K), while the remaining 1.9 percent of the economic benefits will likely accrue to counties outside of the service area (\$52K). ***Thus, the Transmission Transformer Bank Replacements Program is projected to generate more than \$2.8 million in total economic benefits for South Carolina during its 30-year benefit period, including \$1.2 million in secondary economic benefits.***

## **Duke Energy Grid Improvement Plan (GIP) Economic Benefits Assessment**

### ***Program: Targeted Underground (TUG)***

*Prepared by: Joseph Von Nessen, Ph.D.*

*Last Revised: 3/5/19*

### ***Measuring Primary and Secondary Economic Benefits***

Duke Energy estimates that approximately 28,189 South Carolina customers will experience benefits from the TUG program initiative throughout its complete 30-year benefit period. Approximately 23,338 (82.8%) of these are residential customers while the remaining 4,851 are non-residential. A total of 19 projects in South Carolina will be included as part of the TUG program initiative.

In order to determine some of the *primary* economic benefits that are likely to result from this program, Duke Energy's forecasts were combined with data on the number and type of customers that will be affected and then used these data as inputs into the Interruption Cost Estimate Calculator (ICE) developed by the U.S. Department of Energy. The ICE model specifically calculates the average interruption cost for residential, business, and commercial customers using a regression model that takes into account factors such as the duration of the outage, the industry affected, household demographics patterns, and various seasonal factors.<sup>1</sup> By estimating the interruption costs associated with current projections vs. projections that take the TUG program into account and then subtracting the latter from the former, the annual direct cost savings to impacted customers can be determined.

These direct cost savings, however, do not represent the full economic benefits of the TUG program. When businesses experience these cost reductions, over time they will begin to expand their economic activities through additional purchases of raw inputs and the hiring of additional employees. These are known as secondary economic benefits. Additional secondary economic benefits will also accrue to a variety of local businesses when residential customers spend wages with these local businesses that they are no longer losing as a result of temporary employer shut downs.

Thus, both *primary* and *secondary* economic benefits are generated as a result of the program that, together, represents the total economic benefits of the TUG program initiative. To specifically estimate the secondary economic benefits, the *IMPLAN* economic model is used.

### ***Main Results: Economic Benefits of TUG Program Initiative***

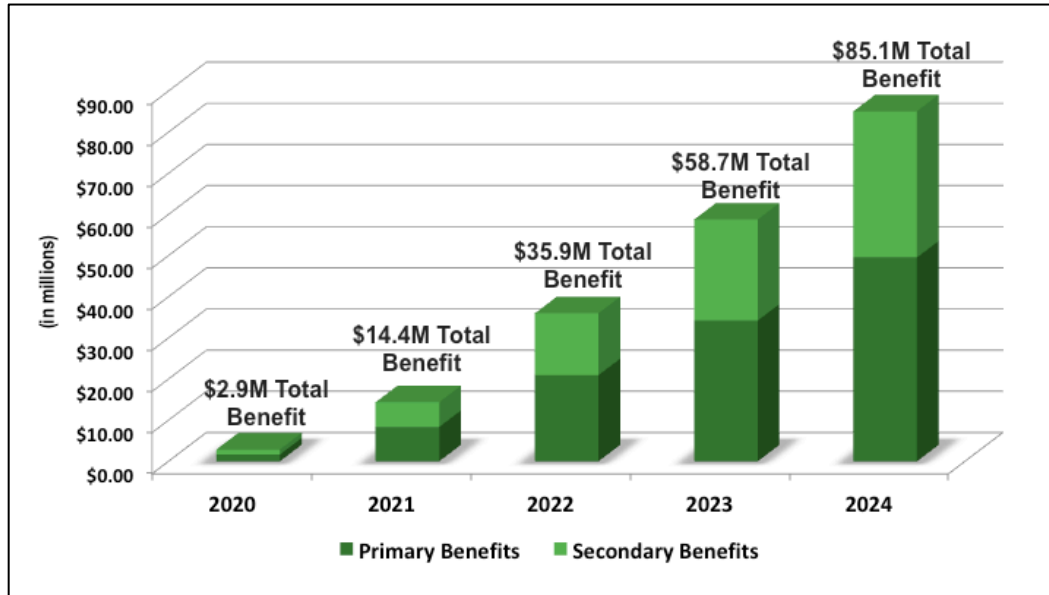
Figure 1 summarizes the total cumulative economic benefits (primary and secondary) in South Carolina resulting from the TUG program initiative during the first five years in which customers will experience benefits. Note that these benefits

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<sup>1</sup> Additional detailed methodology on the ICE model can be found at <http://icecalculator.com>

increase over time (between 2020 and 2024) as new infrastructure comes online. In sum, the cumulative economic benefits will total \$85.1 million by the year 2024.<sup>2</sup>

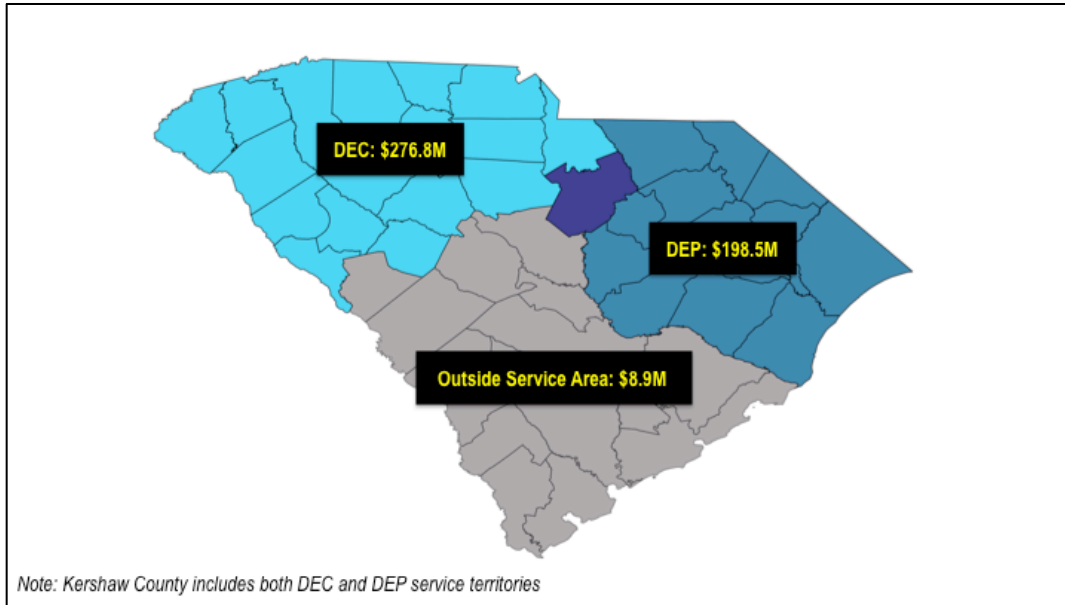
**Figure 1: Cumulative Economic Benefits of TUG in SC: 2020-2024**



The majority of the economic benefits resulting from the South Carolina TUG program will accrue to counties in which the Duke Energy service territory extends. However, the benefits will not be distributed equally. In addition to the fact that Duke Energy customers are not equally distributed within the service territory, economic benefits resulting from improvements that accrue to Duke Energy customers will also generate economic spillover effects to the surrounding regions. These spillover effects come in the form of both additional spending with vendors/suppliers on the part of non-residential customers and the spending of additional earned wages on the part of residential customers. Not all spending activities on the part of Duke Energy customers take place within the Duke Energy service territory – thus a portion of the total economic benefits resulting from TUG improvements will extend statewide. Figures 2-3 show the regions projected to experience the largest percentage of these economic benefits over time.

<sup>2</sup> All economic benefits are expressed in current (2019) dollars.

**Figure 2: Cumulative Total Economic Benefits of TUG in S.C. by Service Area**



Approximately 57.2 percent of the total economic benefits associated with the TUG upgrades are estimated to accrue to the Duke Energy Carolinas (DEC) service territory, which is projected to total approximately \$276.8 million during the 30-year benefit period. Roughly 40.9 percent of the total benefits are estimated to accrue to counties within the Duke Energy Progress (DEP) service territory (\$198.5 million), while the remaining 1.9 percent of the economic benefits will likely accrue to counties outside of the service area (\$8.9 million). ***Thus, TUG improvements are projected to generate more than \$484 million in total economic benefits for South Carolina during its 30-year benefit period, including \$202.1 million in secondary economic benefits.***

**Figure 3: Cumulative Total Economic Benefits of TUG in S.C. by County**

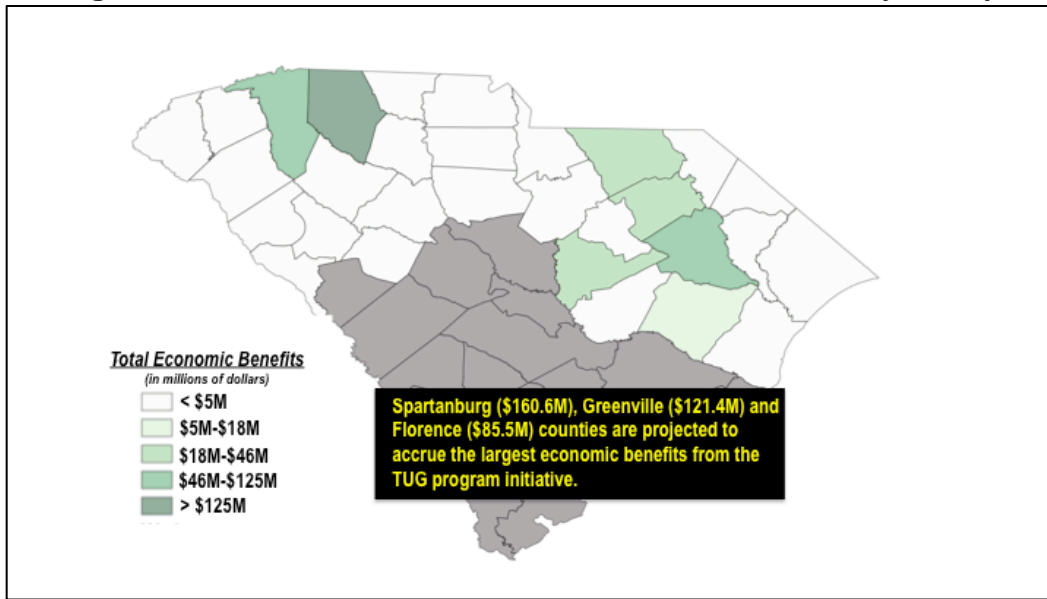


Figure 3 illustrates the breakdown of the total economic benefits associated with the TUG program initiative by county. Note that Spartanburg (33.2%), Greenville (25.1%), and Florence (17.7%) counties are projected to experience the largest economic benefits, followed by Sumter (9.5%), Chesterfield (5.7%), and Darlington (5.0%). The high concentration of customers within Spartanburg, Greenville, and Florence counties is what generates the disproportionately large economic benefits in these regions.

The primary and secondary economic benefits of the TUG program initiative in South Carolina can also be broken down by project. These individual estimates are displayed in Table 1.

**Table 1: Cumulative Total Economic Benefits of TUG in S.C. by Project**

Project Title	Primary Benefits	Secondary Benefits	Total Benefits
Converse Heights – E. Sherwood	\$41,823,890	\$29,962,614	\$71,786,505
Merrifield Park	\$5,406,517	\$3,873,226	\$9,279,743
Park Hills	\$31,546,985	\$22,600,244	\$54,147,230
Woodside	\$12,815,074	\$9,180,713	\$21,995,787
Hall Circle	\$6,260,809	\$4,485,240	\$10,746,049
Hamden Circle	\$9,497,010	\$6,803,654	\$16,300,664
Cedar Springs	\$896,414	\$642,191	\$1,538,605
Chanticleer	\$23,112,968	\$16,558,119	\$39,671,087
Del Norte	\$10,313,780	\$7,388,786	\$17,702,566
Hampton Heights	\$17,344,085	\$12,425,294	\$29,769,380
Ind. - Providence	\$19,076,531	\$13,666,417	\$32,742,948



<b>Project Title</b>	<b>Primary Benefits</b>	<b>Secondary Benefits</b>	<b>Total Benefits</b>
Spartanburg County Club	\$1,964,238	\$1,407,179	\$3,371,417
Arrowwood	\$41,405,160	\$29,662,636	\$71,067,795
McFarlin St	\$10,986,901	\$7,871,011	\$18,857,912
Mimosa Dr	\$423,086	\$303,099	\$726,185
Sherwood	\$26,795,443	\$19,196,242	\$45,991,684
Yaupon Dr	\$14,027,317	\$10,049,163	\$24,076,480
Alleghany Ridge	\$4,150,082	\$2,973,117	\$7,123,199
Tara Village	\$4,304,530	\$3,083,763	\$7,388,293
<b>Totals</b>	<b>\$282,150,822</b>	<b>\$202,132,708</b>	<b>\$484,283,530</b>